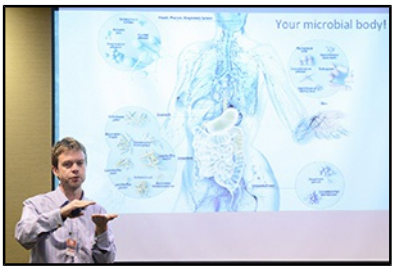
Gilbert sheds light on the microbiome and its invisible influence on health

By Deepa Singh

The fascinating world of the microbiome and its influence on human health and disease was the topic of a May 7 Keystone Lecture Series talk by Jack Gilbert, Ph.D., from the University of Chicago and Argonne National Laboratory.



"The vast majority of the microbial biomass, about 2 to 3 pounds, is present in our intestine, and the rest of them are structured mostly around our skin, which is the largest organ in our body," said Gilbert. (Photo courtesy of Steve McCaw)

Gilbert brought his training as a microbial ecologist to bear, describing the microbiome as a sphere in which microorganisms interact with their environment, with each other, and with their hosts. "The bacterial world is fundamentally adapting to the environment in which it finds itself or is exposed to," explained Gilbert. "It sees lot of changes around it, which are not very different from the changes it has seen throughout its evolutionary history."

According to Gilbert, there are trillions of bacterial cells in our bodies, or two to three times more than the number of human cells. Better knowledge of the human microbiome is thus beneficial in understanding the therapeutic responses to clinical interventions.

Linked Audio

Listen to Gilbert discuss sequencing the microbiome in the Naked Scientists interview, "Stopping Superbugs." (6:30)

Lisa Chadwick, Ph.D., who is a program director in the NIEHS Genes, Environment and Health Branch, hosted Gilbert's talk, which attracted a room full of NIEHS scientists. (Photo courtesy of Steve McCaw)

Microbes influence allergies and behavior

Gilbert emphasized that microbes are present everywhere. "Therefore, every eukaryotic organism had to evolve mechanisms to deal with microbes, and the immune system is probably the key to this evolutionary process," he said. By citing examples involving allergies to peanuts and cow's milk, Gilbert demonstrated the importance of bacteria to autoimmune responses. In both cases, the addition of certain bacteria played a role in alleviating symptoms of the allergic response.

According to Gilbert, microbes in the gut can also affect our brain function and may influence the risk of neurological disorders, including autism, anxiety, and depression. "Changing diet or adding microbes into the diet can drive the disordered phenotype or disordered microbiome back to the ordered one," Gilbert said, referring to studies of maternal immune activation in mice. He also described studies in which fecal microbial transplants showed promising results for relieving symptoms of autism.

Biodiversity of microbes

People who work or live together are microbially more similar than the people who do not, and our built environment also affects these interactions with microbes, Gilbert said.

The Home Microbiome Study looked at the microbial diversity of a group of U.S. families over six weeks and found that humans alter the microbiome of a space when they occupy it. According to Gilbert, who led the study, every family that comes together shares their unique microbiome signature with the house.

Another of his projects, the Hospital Microbiome Study, set out to understand how microbial communities develop in a hospital. "Before the hospital was open, the microbial diversity was very low," Gilbert said. "As soon as the hospital opened, it elevated, and the vast majority of the bacteria came from particles released from patients."

Gilbert hopes these studies will increase scientific understanding of how microbial community structure is shaped by environmental factors. He emphasized that this would be important knowledge for the health care system, potentially leading to a reduction in disease outbreaks and antibiotic resistance.

Citations:

Berni Canani R, Gilbert JA, Nagler CR 2015. The role of the commensal microbiota in the regulation of tolerance to dietary allergens. Curr Opin Allergy Clin Immunol 15:243–249.

Gilbert JA, Krajmalnik-Brown R, Porazinska DL, Weiss SJ, Knight R. 2013. Toward effective probiotics for autism and other neurodevelopmental disorders. Cell 155(7):1446–1448.

(Deepa Singh, Ph.D., is a visiting fellow in the NIEHS Mechanisms of Mutation Group.)

"Our Microbes, Ourselves"

By Kelly Lenox

Lisa Chadwick, Ph.D., presented the eighth Big Picture, Small Talk on May 6, highlighting the human microbiome and its contribution to health. "Microbes coat any surface of your body — inside and out — that they can," Chadwick said in her talk, "Our Microbes, Ourselves." The audience came from all divisions of the institute.

Chadwick listed some of the useful jobs microbes perform:

- Helping digest foods, making essential nutrients available.
- Synthesizing chemicals that our bodies cannot make.
- Increasing available amounts of chemicals we do make, such as serotonin.
- Helping develop the immune system.
- Protecting the body from dangerous bacteria, known as pathogens.

Although the kinds and amounts of bacteria at a given body site may differ from one person to another, Chadwick explained that those microbes generally perform a similar set of biological functions. Normal life events, including fever, antibiotics, and dietary changes may temporarily alter a person's microbiome, but it will usually return to its normal state. She cautioned that widespread use of antibacterial soap and other personal products containing antimicrobial agents may also affect our microbiome.

Researchers are beginning to associate certain diseases with changes in the microbiome, according to Chadwick. "But the field is still new enough that we don't have a lot of examples showing cause and consequence," she said.

Chadwick also discussed NIEHS-funded studies related to the microbiome, such as the effects of arsenic exposure. The effects may work both ways, she said, in that the microbes may metabolize the contaminant, and at the same time, the contaminant may affect the makeup of the microbiome.

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